

## Observations and modelling combine to inform network developments.

Gordon Brailsford<sup>1</sup>, Rowena Moss<sup>1</sup>, Sara Mikaloff Fletcher<sup>1</sup>, Dan Smale<sup>1</sup>, Zoë Buxton<sup>1</sup>, Kay Steinkamp<sup>2</sup>, Sylvia Nichol<sup>1</sup>, John McGregor<sup>1</sup>, Tony Bromley<sup>1</sup>, Peter Sperlich<sup>1</sup>, Graham Timpany<sup>1</sup>, Sally Gray<sup>1</sup>.

<sup>1</sup>National Institute of Water and Atmospheric Research,

<sup>2</sup>Independent researcher

\* Gordon.Brailsford@niwa.co.nz

The New Zealand monitoring network has developed over four decades from a single observation station at Baring Head (41.41°S, 174.87°E), (Brailsford et al, 2012) monitoring CO<sub>2</sub> in baseline conditions, to three active in situ stations that now provide continuous observations of atmospheric CO<sub>2</sub>. The additional observation stations have been in the Central Otago region of the South Island at Lauder (45.034°S, 169.68°E), and the Central North Island at Maunga Kākaramea (38.33°S, 176.38°E). With time the use of CO<sub>2</sub> data has changed, from understanding the southern hemisphere seasonal cycle of CO<sub>2</sub>, to informing on longer term trends. In recent years the National Institute of Water and Atmosphere (NIWA) have developed a regional inverse modelling capability (Steinkamp et al, 2017). Initial assessments utilised two observation stations and revealed differences between the current bottom up national inventory and the top down approach from observation and inverse modelling.

Following this study an assessment was undertaken to develop an enhanced observation network for CO<sub>2</sub> that would provide a greater national coverage in the observations and therefore increased input for the inverse modelling. This study revealed three main geographic regions that currently lack strong visibility. Consideration of three key national CO<sub>2</sub> source/sink processes, forests, pasture and urban, ensure that the placement of stations add significant value to the National Inventory Reporting. We present the process of determining the site locations, through back trajectory analysis, topography and meteorology and source region studies. The enhanced network would provide a high degree of coverage nationally, and include the addition of 2 to 6 new observing stations in the three regions identified.

The sites would be based in Southland with contributions from Fiordland, a large mature forest area that is uninhabited, which appears to be a significant carbon sink. Monitoring in Canterbury will have exposure to farmlands that are a mixture of cropping and livestock farms. The largest city in New Zealand, Auckland will be the focus of the urban study with a series of stations located across the urban area to identify carbon processes in this urban environment.

Brailsford, G.W., Stephens, B.B., Gomez, A.J., Riedel, K., Mikaloff-Fletcher, S., Nichol, S., and Manning, M.: Long-term continuous atmospheric CO<sub>2</sub> measurements at Baring Head, New Zealand, *Atmos. Meas. Tech.*, 5, 3109–3117, doi:10.5194/amt-5-3109-2012, 2012

Steinkamp, K., Mikaloff Fletcher, S. E., Brailsford, G., Smale, D., Moore, S., Keller, E. D., Baisden, W. T., Mukai, H., and Stephens, B. B.: Atmospheric CO<sub>2</sub> observations and models suggest strong carbon uptake by forests in New Zealand, *Atmos. Chem. Phys.*, 17, 47-76, doi:10.5194/acp-17-47-2017, 2017.